MAIN ARTICLE

Community and programmatic factors influencing effective use of system dynamic models

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Abstract

Despite knowledge of factors that enable effective system dynamics modeling and organizational change, real-life application of these tools in community settings remains challenging and often produces mixed results. We undertook a two-part evaluation of early community use of the ReThink Health Dynamics Model (RTH model). The RTH model is a realistic, but simplified, portrait of a regional health system that supports multisector planning and strategy design. We assessed the contextual characteristics and implementation processes that promoted or undermined effective engagement with the model in five pilot sites. These learnings were used to refine a community readiness framework (Elements Affecting Modeling Use) that was then used to select and design a sixth community engagement. We use the evaluation results to assess the value of this organizing framework to identify communities ready for engagement with validated system dynamics models. Enabling better community–model matches will accelerate model adoption and health system transformation.

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Introduction

At a workshop at the 2014 Systems Dynamics Conference in Delft, Netherlands model developers expressed a general frustration with the lack of adoption of well-validated models. Modelers wish for their tools to have great impact, while community practitioners are stymied in their ability to generate sustainable, multisector solutions to entrenched problems without insights from a systems perspective. Despite these seemingly complementary needs, all too often an effective match is not made between the tools and the communities desiring insights.

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The need for models for health improvement

To meaningfully improve population health, communities must take a broader perspective and address the full scope of factors that drive wellness, including those outside of traditional health care (Kindig and Stoddart, 2003). This requires better collaboration among health delivery organizations; the public health sector; and nontraditional health partners, such as those in housing, community development, education, and transportation (Robert Wood Johnson Foundation, 2014).

Local health systems and their multisector partners are looking for tools that enable them to create a shared understanding of the system they seek to change. System dynamics simulation models are a useful tool that can help local partnerships build stronger collaboration, create shared vision, identify high leverage strategies, and explore collaborative investment opportunities (Erickson *et al.,* 2017). System dynamics modeling can assess both the comparative effectiveness and cost effectiveness of novel interventions ("what-if scenarios") without costly, time-consuming, and risky direct experimentation (Homer and Hirsch, 2006; Marshall *et al.,* 2015).

While the literature highlights the appropriateness of applying modeling to the challenge of health system transformation (Greenhalgh *et al.,* 2009; Best *et al.*, 2012; Kwakkel and Pruyt, 2015), less is known about the preconditions that enable effective model use in communities. Today, system dynamics practitioners still face a range of unanswered questions about how to match their established models with the communities ideally situated to engage with the model and to make effective use of insights gained.

A gap in practice

Existing literature in system dynamics identifies best practices for modeling, including clear problem formulation and the importance of stakeholder buy-in (Forrester, 1988; Richardson and Pugh, 1981; Sterman, 2000; Hovmand, 2013; Martinez-Moyano and Richardson, 2013). Simultaneously, researchers in organizational change have theorized about drivers of effective change (leadership, vision and clarity of goals, communication, training, and participation), as well as barriers to sustainable change (managerial style, organizational structure, lack of strategic clarity, and absence of engagement) (Rogers, 1995; Griffith, 2001; Probst and Borzillo, 2008; Beer *et al.,* 2016). Yet, despite these seemingly well-elucidated factors for success, countless collaboratives attempting to make systematic changes have floundered (Senge *et al.,* 2015; Siegel *et al.,* 2018).

The lack of application of research findings to real-life settings is a well-known problem (Brownson *et al.,* 2017), referred to as the knowing–doing gap (Pfeffer and Sutton, 2000; Graham *et al.,* 2018). Even when adoption of new ideas, processes, or tools offers clear advantages, there is still often a

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significant delay before adoption. This gap between evidence generation and adoption is acknowledged in the field of health care and across other sectors (Griffith, 2001; Institute of Medicine Committee on Quality of Health Care in America, 2001). Passive dissemination of evidence (e.g., publishing findings in journals) notoriously fails to catalyze the adoption of new tools or practices (Bero *et al.,* 1998). So, innovators face the practical question of how to speed adoption. How can model developers seeking to make an impact with their tools find communities with the capacity to effectively engage?

While the group model-building literature has identified factors supporting effective model use, there has not been much evaluation assessing the applicability of these factors to support the effective use of existing models. Based on elements identified in the system dynamics and organizational change literature, we developed a framework that enables model developers and community leaders to assess current readiness based on contextual and engagement characteristics and processes shown to increase effective model use. Further validation of this community readiness framework can help move the modeling field forward in getting well-established models into more widespread, effective, and system-changing use.

Methods

To improve the matching of dynamic simulation modeling to regional health system transformation efforts, we undertook a two-part evaluation of early community use of the ReThink Health Dynamics Model (RTH model). In the exploratory phase, we conducted a 1-year developmental evaluation assessing the contextual characteristics and implementation processes that promoted or undermined effective engagement of the RTH model in five pilot sites. These learnings were used to refine a community readiness framework (Elements Affecting Modeling Use) that was then used to select and design ReThink Health's next community engagement.

ReThink health dynamics model

The RTH model is a realistic, but simplified, portrait of a regional health system that supports multisector planning and strategy design. Representing a US city, county, region, or state, the model simulates changes in population health, health care delivery, health equity, workforce productivity, and health care costs by quarter-year increments from 2010 to 2040 (Homer *et al.,* 2016). The model contains more than 20 options for simulating the likely effects of interventions that alter health risks, health care delivery, provider payment, or program financing. Each strategy can be simulated individually or in combination (ReThink Health, 2018).

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At the time of this evaluation, ReThink Health had received substantial investment and built a credible model, but it was not yet being used widely. The planned activities for each pilot site included an orientation call, a face-to-face kickoff, data collection and model calibration, a face-to-face policy analysis meeting, and follow-up support. The time spent in each of these activities varied by community, with the total engagement time ranging from 6 to 12 months.

Exploratory phase

We used a realist evaluation lens to analyze the modeling experience of the five communities to understand the range of contextual and intervention characteristics (alone or in combination) that promote or undermine effective use of the system dynamics model in community settings. The evaluation included development of a community readiness framework that served as the schema for all data collection and analysis. The exploratory phase culminated with the refinement of this framework (Elements Affecting Modeling Use) based on learnings from the 1-year evaluation of model use in the five pilot communities.

Five sites

We observed the first five pilot sites as they were introduced to and began to use the RTH model in their local health transformation planning. These sites were chosen because they had interest in using the RTH model, in some cases with encouragement and financial support from outside funders.

The sites varied in location and size of the community:

- Site 1 was located in a small metropolitan area in the Central West with a population of approximately 140,000.
- Site 2 was a community of similar size located in New England.
- Sites 3 was a county located within a major west coast metropolitan area with a population of over 1.5 million.
- Site 4 was located within a suburban area of the Site 3 metropolis, with a population of about 1.2 million.
- Site 5 was located in a small city in the Pacific Northwest with a population of about 160,000.

Realist framework

Realist evaluation provides a useful approach for learning more about the application of models within community groups. Realist evaluation provides a "logic of inquiry" for answering the questions "What works for whom in what circumstances?" (Pawson and Tilley, 1997). Findings from realist

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evaluations support effective practice by explaining the complex signature of outcomes based on examining the relationships between the context, mechanism, and outcomes (Pawson and Tilley, 1997). The realist evaluation cycle includes four components: (i) eliciting and formalizing the program theories to be tested; (ii) collecting data on appropriate context, mechanism, and outcome attributes; (iii) analyzing context–mechanism–outcome patterns to see which can be explained by the initial theory; and (iv) revising the program theory based on new insights related to the context–mechanism–outcome configurations as a prelude to further rounds of theory refinement (Pawson and Tilley, 1997).

The realist lens was selected for the evaluation framework as it enables use of mixed data types, explores the mechanisms underlying associations and correlations in data, and refines program theory through real-time incorporation of learnings (Rouwette *et al.,* 2002; Pawson and Manzano-Santaella, 2012).

Defining the program theories to be tested

The evaluation team developed initial program theories regarding: contexts (e.g., settings and participant characteristics); mechanisms (e.g., the engagement and interactive experiences); and outcomes (e.g., insights and consequences among individuals, groups, organizations, and systems) hypothesized to impact effective model use in the pilot communities. These program theories were based on initial interviews with ReThink Health team members, a review of the literature (including health system transformation and system dynamics modeling), and supplemental insights from veteran practitioners. Elements of the program theories were organized by realist constructs to form an initial evaluation framework, Elements Affecting Model Use (Table 1).

While there is need for rigorous, long-term, prospective follow-up to measure the impact of modeling use on health system transformation (e.g., improvements in health equity and health outcomes), that scope of inquiry is beyond the intended purpose of the exploratory phase of this evaluation. Since population health outcomes related to the health system transformation would not be measurable in a 1-year timeframe, outcomes evaluated in the exploratory phase were related to changes in user perspective and group dynamics as a result of model use. These near-term effects are considered outcomes by realist standards (Rouwette *et al.,* 2002).

Collecting data

The initial Elements Affecting Model Use framework provided the schema for all data collection and was systematically applied within and across cases. Real-time data collection activities included on-site observation, observation of calls and webinars, email content review, website and other

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Table 1. Elements affecting model use

Context Independent of the model activities	Mechanism Process of the modeling intervention	Outcomes Effects of modeling use
Community collaborative • Composition and size—decided how? ◇ Influence of members ◇ Organizational diversity • Affiliation • Culture (i.e., conflict, learning, collective action) • Formality ◇ Leadership capacity ◇ Convening stakeholders ◇ Managing data ◇ Use of the model ◇ Championing the process • Geography • Resources ◇ Relationships ◇ Quality of interactions ◇ History of working together (time together, evolution of partnerships, other projects and accomplishments) **Health System** • Provider viability • Local ACA activity (including ACOs) • System integration and financing **ReThink/ReThink** • Participation in other ReThink interventions **Problem identification/selection** • Extent to which stakeholders have information regarding the problem (analytical dimensions) • Stakeholders in dispute regarding problem (social dimensions) ◇ Clearly identified problem (plan for the use of the model)	**Pre-project activities** • Who initiated contact ◇ Contracting ◇ Sponsorship ◇ Role of Sponsor ◇ Capacity of Sponsor ◇ Receptivity of the individual sites ◇ Direct • Initial reactions and deliberations • Motivation for initiating the intervention—training, implementation of solutions, etc. • Initial expectations and goals (implementation of results, etc.) • Modeling/facilitation team and relative roles **Model** • Process for developing model • Sources of information • Process for eliciting knowledge • Size and dynamic complexity • Level of community engagement in model development (model development vs. customization/ calibration) • Role of modelers ◇ Clearly defined geography the model will cover **Facilitation/support** • Self-directed vs. facilitated • Extent of support (modeling assistance vs. continued facilitation, guidance, and interpretation) • Meetings—content, process, • Time investment • Modelers • Facilitator • Community participants • Duration of intervention • Facilitator role and participant perceptions (e.g., neutrality, credibility) • Follow-up activities	**Individual** • Reaction to the model—value added, ownership, trust • Learning and Insights—broader perspective of the system in which they work, understanding of the problem, trade-offs, consequences of inaction, leverage points (high–low) • Commitment to implement the results of the model • Changed behavior **Group** • Exchange of viewpoints; focus constructive conversation • Alignment—"shared view" • Shared language • Engagement of key stakeholders • Capacity for collective stewardship **Organization/system** • Actions taken change the system (slighted modified from literature) • Results of system changes • Effective uses for simulated scenarios (align resources, create partnership, advance policy, a deal, a program, a contract) **Methods** • Further use of modeling, systems thinking ◇ Ability to use the model independently run simulationsd • Modeling seen as a more efficient means than tackling similar problems with more conventional methods ◇ Identifies other models that could be used to support decision making

Key:
• Domains identified pre-study based on literature and veteran practitioner insights.
◇ Additional domains added based upon observed patterns during the evaluation.

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descriptive information about each site, document review, participant surveys, and structured interviews with members of the modeling team and local project participants.

Analyzing data

The evaluators were independent from the modeling team. However, real-time sensemaking and rapid feedback, inherent in the developmental evaluation design, informed ongoing decisions made by the practitioners and site leaders. The collaborative evaluation process focused on understanding the community and engagement conditions under which the model was most valuable.

A team of three evaluators coded data for the sites individually in a non-blinded fashion consistent with realist evaluation quality and reporting standards (Wong *et al.,* 2017). Consensus agreement validated individual site coding. The coding scheme mapped data to each of the items within the Elements Affecting Model Use framework and enabled the identification of patterns within and across communities.

Revising the program theories

In addition to testing the robustness of the initial hypotheses, the evaluation design allowed for the inclusion of emerging factors relevant to modeling practice that were not included in the initial Elements Affecting Model Use framework. As a result, the framework was modified based on learnings from the five pilot sites to reflect new context-, mechanism-, or outcome-related insights appearing to influence effectiveness of model use. Adjusted elements are denoted on Table 1.

Translation phase

ReThink Health rapidly put learnings from the exploratory phase into practice and piloted the framework in selecting and designing its sixth modeling engagement with the Atlanta Regional Collaborative for Health Improvement (ARCHI).

Observations

Exploratory phase

The five pilot sites did not demonstrate equal readiness for or effectiveness in engaging with the RTH model. Below we discuss seven elements that seemed to foster a greater match between the model and the users during the RTH engagement (Table 2).

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Table 2. Summary of key context–mechanism–outcome observations across sites

	Community 1	Community 2	Community 3	Community 4	Community 5
Context domain elements					
Community collaborative characteristics					
Composition and size	✓				✓
Influence of members	✓				✓
Relationships	✓				✓
Leadership capacities					
Convening stakeholders	✓	✓	✓	✓	✓
Managing data	✓	✓			✓
Use of the model	✓				✓
Championing the process	✓				✓
Clearly identified problem for model use	✓				✓
Mechanism domain elements					
Sponsorship (internal)	✓	✓			✓
Clearly defined geography for model	✓			✓	✓
Outcome domain elements					
Observed effects of modeling use					
Individual	✓	✓	✓	✓	✓
Group	✓	✓	✓		✓
Organization/system	✓				
Further use of modeling	✓				✓

Clearly identified problem for model use

Problem and system conceptualization are core to building useful models (Richardson and Pugh, 1981). But the actual utility of the model is dependent upon a match between the scope of the community's defined problem and the capabilities of the model. This element of matching the problem to the model was not included in the original Elements Affecting Model Use framework, but was observed to be an important issue. In the five sites, the scope of the problem was characterized as "limited", "broad", or "unknown". The RTH model was designed to foster whole-scale transformation of the health system in a region. For communities without such an ambitious agenda, the RTH tool was not a fit. Only two communities had scopes of problem identification that fully matched the capabilities of the model, which resulted in these two collaboratives being able to make much better use of the model. The other sites struggled with a tension between their tendency to focus on detailed tactics in particular sectors of the health system, such as whether to add a new Federally Qualified Health Center, whereas the RTH model posed strategic questions across a wider boundary using a higher level of aggregation.

Clearly defined geography for the model

The geography to be covered by the model emerged as an important decision point for the collaboratives. The pilot sites spent a surprising and inordinate

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amount of time discussing whether to focus on a wider or narrower geography—a choice that tested both leadership and knowledge of migration patterns across the region. When these debates became protracted, they not only slowed progress in calibrating the model but also undermined momentum for model use by creating discord among stakeholders and taking focus away from other questions that needed attention.

Influence of members

Among the community collaborative characteristics, the collaborative members' influence emerged as a key element of effective model use. In two sites senior leaders with clear moral authority were directly involved in the collaborative and the modeling process. Their leverage was most visible in their ability to articulate systemic challenges and their power to bring other key leaders into the process. At their best, leaders embraced a sense of system stewardship that positioned all members of the collaborative as potential change agents within a common health system. However, in three collaboratives the most influential representatives of the stakeholder organizations were not willing or able to get the right people on board. In those situations, there was a leadership vacuum and members of the group tended to be more concerned with narrow self-interests than the overall performance of the regional health system.

Sponsorship

The initiation and source of funding supporting model use predicted the motivation to maintain full engagement with the RTH model. Three pilot sites with internally driven sponsorship had an increased readiness for the RTH engagement. Partners in these internally motivated sites had a longer history of working together and a more developed sense of community need.

The two sites that were externally recruited by a foundation to participate in the modeling process had the least successful match and engagement with the model. These two groups were not established collaboratives and formed for the purpose of the RTH engagement. This led to challenges in clearly identifying a shared problem, as the sites were not engaging with the model due to an internally identified need. Their receptivity to participate was driven by the influence of the sponsor. This pattern matches the experience of other collective impact initiatives that have proven to be "artificial, awkward, and unsustainable" when funders drive the convening in the absence of a grassroots-initiated, shared vision (Easterling, 2013).

Championing the process

A community's motivation for use of models stems from a belief in the model's practicality as a strategy design tool. With this belief, a cheerleader

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emerges that publicly supports the utility of the model to gain an understanding of the systemic drivers of an entrenched local problem. This type of champion, who fundamentally believes the model is useful, was clearly present in two of the five communities.

Frequently, though, participants fall into other extreme categories: the skeptic or the mystic. Skeptics distrust the model, whereas mystics have an over-reliance on the model and look to the model as an oracle that will tell the community what to do. In the three pilot communities lacking a champion of the modeling process, skeptics had more sway and much time was spent on the model's inner workings rather than building trust in the process.

Managing the data

ReThink Health designed the model to be flexible, and, through scaling national data, can represent virtually any region in America. However, collaboratives involved in this pilot phase had the opportunity to incorporate local data and tailor the model to better represent their region. Local capacity to gather relevant data was not equally available in the five sites. Three communities demonstrated local data capacity. For the two newly formed collaboratives that had been externally recruited to participate, securing quality, local data was a problem. This caused significant delays in the process, which impacted use and momentum.

Further use of modeling

Use of the model beyond the expected planning timeframe and scope of the ReThink Health engagement is a near-term outcome that could be captured in the 1-year evaluation. The local capacity to independently use the RTH model emerged as a sign of maturity. Among the five sites, two with stronger data management capacity were able to use the model independently to run additional scenarios. In one case, the model's scenarios were included in a proposal for foundation funding that ultimately yielded a large grant to support their organizational infrastructure. This ability became known as a local "keeper of the model". As might be expected, the sites that demonstrated weaker engagement with the RTH model over the 1-year study period also showed limited ability to independently use the model beyond the initial application (e.g., with new stakeholders).

Translation phase

As the five pilot sites demonstrated, having a technically sound model is not enough to assure widespread and effective use in the community setting. The power of the modeling tool must be combined with substantive

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elements indicating community readiness to enable effective modeling use (Hovmand, 2013).

The insights gained from the five pilot sites were used to refine the Elements Affecting Model Use framework. At this point, ReThink Health intended to use the framework as a tool to evaluate preconditions in a given community against those preliminarily shown to increase the likelihood of a good fit between the model and the community users. ReThink Health piloted the framework in its engagement of its sixth site, ARCHI.

One of the pilot evaluators played a lead role in ARCHI and ultimately served as a champion for the use of the RTH model. Having observed the five pilot sites, she recognized that the conditions highlighted in the framework either existed in Atlanta or could be cultivated. Thus ARCHI structured its use of the RTH model based on the key learnings from the pilot evaluation that were encapsulated in the refined Elements Affecting Model Use framework.

Clearly identified problem for model use

Eleven Atlanta-based organizations came together in 2011 to explore how local health systems might collaborate on new requirements in the Affordable Care Act, including how to incentivize a joint community health needs assessment for the benefit of multiple health systems and public health departments. Over the course of 1 year, the group transitioned from an informal gathering of colleagues to actively soliciting involvement and investment from partners in other sectors to address the multigenerational challenge of significant health disparities in the city's core. Three of the 11 founding organizations—the Georgia Health Policy Center, the Atlanta Regional Commission (an intergovernmental planning agency), and the United Way of Greater Atlanta—emerged to lead ARCHI.

From its inception, ARCHI stakeholders agreed to take a broad view of the health system and to spend time building a common understanding of the relationships between health and other sectors, including education, transportation, workforce development, and housing. ARCHI partners and leaders were united by a dissatisfaction with the status quo and shared a desire to develop a long-term vision for a healthier and more equitable Atlanta (Minyard *et al.,* 2016).

As part of the efforts to build a common understanding of the health system and its relationship with other sectors in Atlanta, the ARCHI steering committee became interested in using the RTH model as the capstone to a high-level, regional community needs assessment. In short, ARCHI's identified problems, transformational goals, and desire to understand the system matched the intended use of the RTH model.

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Clearly defined geography for the model

Upon engagement with ReThink Health, ARCHI benefited immediately from the experiences of the exploratory sites. The observations highlighted ARCHI's need to define the geography of interest early in the process. Leaders quickly decided to focus on two core counties (DeKalb and Fulton) as opposed to the entire metro region (with 22 counties). This pivotal decision helped to attract local leaders from the two designated counties, while preventing the group from spending precious time on a protracted process.

Influence of members

ARCHI orchestrated a powerful confluence of events. They gathered the right people to look at the big picture at the right time using a new tool that enabled systematic exploration of the community's challenges. The 15-member steering committee had long-standing, working relationships, as well as some familiarity and experience with system thinking. The steering community members used their influence and convening expertise to bring 70 participants (representing area business, insurers, physicians, hospitals, government agencies, community and faith-based organizations, and educators) to a 1-day event to explore futures for Atlanta's health system. The diversity of participation would later prove crucial to implementing ARCHI's chosen 25-year strategy.

Sponsorship

While there was external sponsorship for the costs associated with applying the RTH model in Atlanta, the desire to engage with the model was internally motivated. Due to participation by an ARCHI steering committee member, model calibration and facilitation were funded by the Centers for Disease Control and Prevention. However, because the request for RTH's modeling support originated from ARCHI leadership, the contract allowed ARCHI to control the process. This is different from the external sponsorships in the exploratory evaluation in which the sponsor took the lead and recruited an individual in the communities to assemble a partnership to use the model.

Championing the process

ARCHI's steering committee recognized that the RTH model could potentially accelerate learning about the system, but that it offered no guaranteed solutions. This pragmatism enabled ARCHI to champion the process effectively and make full use of influential partners. The steering committee undertook a first effort at calibrating the model to ensure their conviction about the model and what it had to offer. After that, the entire steering committee could confidently recruit partners to experience using the model at a

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1-day workshop. ARCHI used the model to both align and "wow" partners. The model became a "magnet" and a tool to enable people to think about the future.

Managing the data

Data management is another area where ARCHI's effective use of the RTH model was accelerated by wisdom drawn from observing the pilot sites. Finding the source for data that encompassed a system perspective was crucial. Relying on a public health epidemiologist was too limiting, as other health care system data were needed to provide a broad picture. ARCHI focused on health economists and established a data partnership with several university faculty members who had the needed access. Additionally, early in the process the team decided that the data partner would become the local "keeper of the model" so that additional scenarios could be run and new partners could experience use of the model first hand.

Continued model use

ARCHI leadership and RTH co-designed the module use workshop. Stakeholders attending the 1-day RTH model workshop were given a lengthy set of interventions they could deploy in the Atlanta area over a 28-year period (2012–2040). These interventions included changes in the delivery of care, expansion of certain kinds of care including primary care and behavioral health services, increases in healthy behaviors, a range of upstream interventions that addressed education and income, and a variety of new methods of financing service delivery. Attendees also drew upon their knowledge of the health system and the Atlanta community, as well as data from the community health needs assessment.

The RTH model allowed the assembled stakeholders to compare and contrast the impacts of different scenarios on the larger health system and the economy. The group used electronic voting to determine which change scenario it would adopt and collectively pursue. With 87 percent support from the diverse stakeholders gathered, the chosen approach became known as the Atlanta Transformation Scenario.

The RTH model was employed by ARCHI to galvanize partners around a common vision of community improvement. The model provided a vehicle for regional participants to explore various potential futures. The result was a rapid movement from absence of strategy to a 28-year blueprint in a single-day workshop (Burke and Albert, 2014).

Workgroups were immediately formed to build a playbook addressing the interventions in the Atlanta Transformation Scenario, including pathways to advantage, care coordination, healthy behaviors, insurance access, capture and reinvest, and innovation funding. For each intervention, workgroups identified evidence-based practices, model assumptions, ongoing local

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activities in the selected area, and the people needed for implementation of the intervention. The resulting compendium of strategies became known as the *ARCHI Playbook* and provided partners with an actionable path forward (Atlanta Regional Collaborative for Health Improvement, 2013). ARCHI envisioned a distributed, collective impact approach to advancing its work. Members were encouraged, supported, and recognized for aligning decisions and activities around these priorities, within and across their spheres of influence. The RTH model and resulting Atlanta Transformation Scenario enabled ARCHI to delineate very specific targets across a range of broad activities.

ARCHI continues to supply encouraging evidence that their engagement with the RTH model accelerated their vision for health system transformation in Atlanta. The collaborative continues to use the Atlanta Transformation Scenario as a strategic guide, with ARCHI-related initiatives mapping directly to components of the scenario. For example, training disadvantaged high school students to become community health workers expanded pathways to advantage, care coordination, and support for healthy behaviors.

Discussion

Matching modeling tools with both a community's needs and its capacity to engage is no small feat. If model developers and community practitioners can be more attentive to the nuances of readiness, the potential audiences for and impact of well-established models can be increased.

Using models to address complex societal change requires carefully orchestrating community engagement. Community stakeholders must be prepared to champion the modeling process, including accepting the utility of the model and its applicability to their context; possessing and leveraging their relationships and convening influence; and managing decisions and processes (e.g., defining geography to be employed and data gathering) during the model engagement. In turn, modelers must convey this practice wisdom in constructive discussion and design of the engagement.

Our preliminary results suggest that the Elements Affecting Model Use framework fosters this discussion between model developers and community practitioners in ways that enhance the likelihood of effective model engagement.

Since the individual elements in the framework were drawn from the existing evidence base in the health transformation, systems dynamics, and organizational change literature, the specific line items may not appear novel. The framework's contribution lies in combining significant elements of practice wisdom in a concise format that is understandable and applicable to both parties in a community-based modeling engagement.

Our exploratory evaluation indicates that collaborative characteristics, leadership capacities, and internal motivation for the project are useful

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elements for identifying patterns of effective engagement between community collaboratives and a model designed to guide strategy around health system transformation. Furthermore, the deliberate, prospective application of these elements in designing a new community-model engagement indicates that these elements increase the effectiveness of model-community engagement, as evidenced by ARCHI's experience.

ARCHI used a disciplined approach to apply the lessons learned from the exploratory evaluation of the first five RTH pilot sites to maximize the effectiveness of its engagement with the RTH model. ARCHI credits engagement with the RTH model for accelerating the dialogue and the agenda around community change (Minyard *et al.,* 2016). The model provided ARCHI systemic insights about interactions of system components, which strengthened collaborative members' shared understanding. In turn, this shared vision assisted in recruiting partners and building a health transformation agenda.

System dynamics models cannot inherently solve complex societal problems. However, when properly matched with community need, the tools can offer glimpses into what is possible. It is up to the community to turn these insights into action. Similarly, the Elements of Model Use framework does not have a mystic ability to predict an ideal model–community engagement. However, it offers prompts for both the model developer and the community practitioner to consider during engagement planning.

Limitations

It should be noted that, while ARCHI credits use of the RTH model for its accelerated success, it represents just one case of how a community can use an existing model. To assess its broader validity, the Elements Affecting Model Use should be tested across a selection of additional ReThink Health sites and by other model practitioners outside of the health field. This evaluation focused on community engagement with a well-established model, so it remains unknown how the findings would apply to a group model-building process. Further testing and refinement of the framework through continued application are central to realist evaluation.

Additionally, as mentioned previously, the exploratory phase of the evaluation encompassed a 1-year engagement timeframe, limiting measures of outcomes to near-term effects of model engagement. Longer-term prospective evaluations are warranted to assess how preconditions associated with effective model engagement hold up over time and translate to measurable outcomes of health system transformation.

Conclusion

Communities use models to understand the systems in which they reside. Our findings around the necessary conditions, while seemingly well known,

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are not always understood by community leaders, particularly in the context of how they influence real-world readiness and effective engagement with models. As large-scale health system transformation is needed to reduce costs and improve population health outcomes, there is increasing need for the expanded use of systems models. We see value in using the organizing framework to identify communities ready for engagement with validated system dynamics models to accelerate both model adoption and, ultimately, health system transformation.

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Biographies

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